[Short title + Author Name - P&H title] 11 (2021) 237–241

Contents lists available at ScienceDirect

African Journal of Emergency Medicine

journal homepage: www.elsevier.com/locate/afjem

Original article

Areas of delay related to prolonged length of stay in an emergency department of an academic hospital in South Africa

Kapari Mashao [a], Tanya Heyns [a,*], Zelda White [b]

[a] University of Pretoria, Department of Nursing Science, Pretoria, South Africa
[b] University of Pretoria, Department of Human Nutrition, Pretoria, South Africa

ARTICLE INFO

Keywords:
Emergency department
Input-Throughput-Output model
Length of stay

ABSTRACT

Introduction: Globally, length of stay of patients in emergency departments remains a challenge. Remaining in the emergency department for >12 h increases health care costs, morbidity and mortality rates and leads to crowding and lower patient satisfaction.
The aim of this research was to describe the areas of delay related to prolonged length of stay in the emergency department of an academic hospital.
Methods: A quantitative retrospective study was done. The Input-Throughput-Output model was used to identify the areas of patients' journey through the emergency department. The possible areas of delay where then described. Using systematic sampling, a total of 100 patient files managed in an emergency department of an academic hospital in South Africa were audited over a period of 3 months. Descriptive statistics and regression analysis was used to analyse data.
Results: The mean length of stay of patients in the emergency department was 73 h 49 min. The length of stay per phase was: input (3 h 17 min), throughput (16 h 25 min) and output (54 h 7 min). A strong significant relationship found between the length of stay and the time taken between disposition decision (throughput phase) disposition decision to admission or discharge of patients from the ED (output phase) ($p < 0.05$).
Conclusion: The output phase was identified as the longest area of delay in this study, with the time taken between disposition decision to admission or discharge of patients from the ED (patients waiting for inpatient beds) as the main significant area of delay.

African relevance

- In Africa, and globally, length of stay of patients in emergency departments remains a challenge
- The Input-Throughput-Output model provide a logical framework to identify areas of delay that prolong patients' length of stay in emergency departments
- We recommend the monitoring and evaluation of length of stay in emergency departments to be monitored
- Strategies should be implemented to decrease the length of stay in emergency departments.

Introduction

Prolonged length of stay (LOS) in the emergency department (ED) is a global challenge as millions of individuals access health care through EDs each year and the number increases annually [1]. Despite the increasing rate of patients seeking health care, the EDs capacities remain overburdened, subsequently leading to overcapacity, crowding and prolonged LOS [1,2].

Prolonged LOS adversely affects the functionality of the ED and quality patient care as it leads to crowding [2–4]. Crowding depletes ED resources such as available staff, equipment, infrastructure and consumables [1,2,5–7]. Staff-patient ratios become inappropriate and increase the burden of the ED health care providers. The health care providers spend more time caring for new admissions, neglecting the care of patients waiting to be admitted in the wards [1,2,5–8]. These patients are less frequently re-evaluated, increasing the risk for medical errors and adverse events, consequently reducing the ED's efficiency [7,9,10]. Crowding and limited resources due to prolonged LOS may reduce access for new admissions, delay care and workups, prolong pain and suffering, delay therapeutic interventions and result in longer

* Corresponding author.
E-mail address: tanya.heyns@up.ac.za (T. Heyns).

https://doi.org/10.1016/j.afjem.2021.02.002
Received 17 September 2020; Received in revised form 20 November 2020; Accepted 1 February 2021
Available online 10 March 2021

hospital stay and costs [3,4,7,9,11]. A depleted infrastructure such as shortage of available beds and treatment areas may further compromise patients' privacy and confidentiality as they are then treated in inappropriate areas such as on a chair in the hallway [12,13]. Prolonged LOS results in patients being exposed to adverse events and not getting optimal and best available care they deserve and would have received when admitted in the specialty wards [7,10].

Prolonged LOS in the ED is recognised as a main concern in many countries (developed and developing), such as Australia [4], Taiwan [14], the United States of America [15], the Netherlands [16], Canada [17], Brazil [18] and Ghana [19]. Many of these countries have tried to reduce the LOS in the ED by setting targets for average LOS in the ED without compromising quality patient care. The United Kingdom's National Health Service set the 'four hour rule' target goal which was later also implemented in Australia [20,21]. Other countries such as New Zealand increased the target time to a 'six-hour target' aiming at reducing LOS without compromising the quality of care [3].

Sub-Saharan African countries recognised that prolonged LOS has become a daily reality affecting the functionality of the EDs and reached consensus that further investigations was vital to try and reduce prolonged LOS in the ED [22,23]. The study conducted in Botswana found that ED waiting times and length of stay were prolonged [24]. Although it was indicated in the study conducted in Nigeria that the ideal ED LOS was 6 h, findings from the study conducted in a teaching hospital ED showed patient ED stay of over 24 h [25].

Due to the quadruple burden diseases and limited resources in South Africa the rate of patients seeking emergency care has increased alarmingly, leading to crowding and subsequently prolonged LOS in the ED [22,26]. Yet, in South Africa, a set target for the average LOS in the ED is not specified [27]. In the study conducted in Cape Town public EDs, health care providers described limited bed availability, staff shortage and high rate of boarders in the ED as outcomes of crowding which lead to prolonged ED LOS [27]. The ED of the study hospital is often understaffed and overburdened as in the case of many similar hospitals in South Africa [28]. The 2014 statistics revealed continuous challenges relating to patients' LOS in the ED – for example, patient remained in the ED for up to 5 days [28] - despite aiming for patients to be transferred form the ED within at least 12-h (informal communication by the head of department). The exact cause of prolonged LOS in the study ED was unknown as measuring waiting times were not routine practice. Thus, the aim of this study was to describe the areas of delay related to prolong LOS in the ED in an academic hospital in South Africa.

Setting

The ED is located in an academic hospital in the public sector with 832 beds, located in Gauteng, a province in South Africa. The ED delivers a 24-hour service and consists of a triage area, trauma resuscitation area (4 beds), medical resuscitation area (2 beds), a female admission area (10 beds), male admission area (6 beds) and an acute trauma admission area (10 beds). Seventy-two nurses and 16 doctors are employed on a permanent basis in the ED. Between 50 and 72 patients are admitted daily, varying from urgent to non-urgent medical, surgical or trauma related emergencies. Thirteen nurses (12-hour) and 3 doctors (8-hour) work shifts in the ED and approximately 40 to 60 patients, awaiting management and or disposition, are handed over to the nursing staff at each new shift.

Conceptual framework

Asplin et al. created a conceptual model which characterized ED operations as having three elements; input, throughput and output [29]. This conceptual model has been used in many studies for studying the ED crowding [30–33]. In this study, the conceptual framework (Fig. 1) is guided by the Input-Throughput-Output model to study the ED LOS [29]. Input is about patient demand for emergency services prior arrival in the ED, which comprises patients' arrival at reception and/or triage. Throughput focuses on the operations and activities implemented to manage patients within the ED including consultations with health care providers (particularly nurses and doctors), conducting of diagnostic tests and referral to specialists. The output represents the admission or discharge of patients from the ED. The areas of a patient's journey through the ED were highlighted in order to identify potential factors that may influence their LOS.

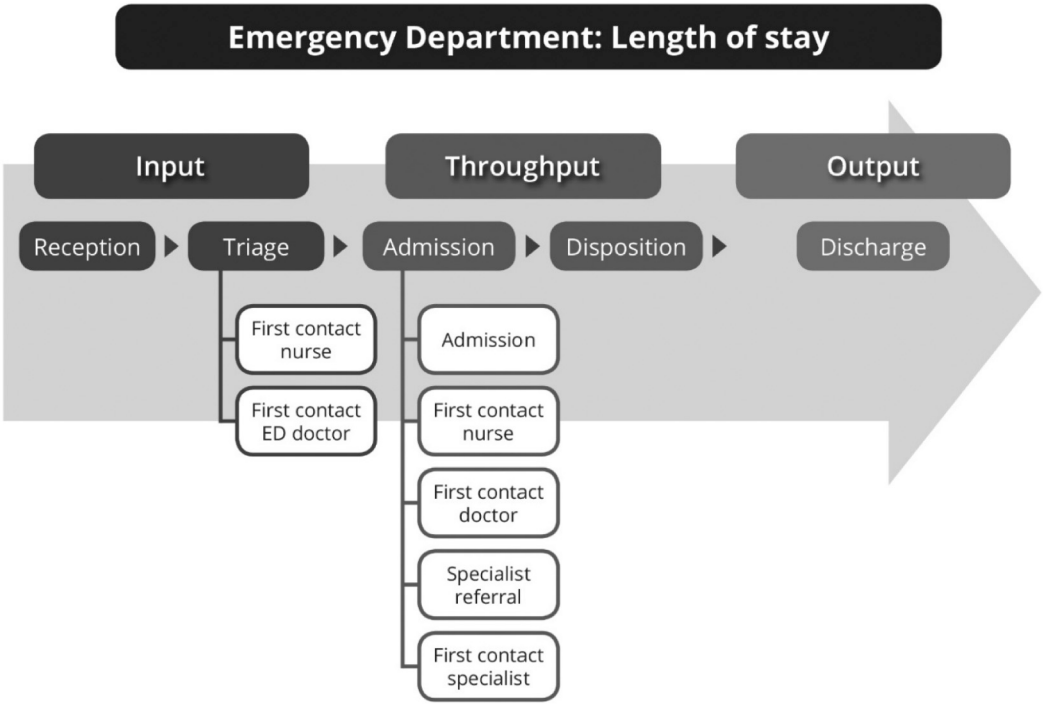

Fig. 1. Conceptual framework representing the areas of a patient's journey through the emergency department.

The input phase includes the patient reporting to ED reception and triage. The throughput phase includes admission to the ED, management as well as referral to a specialist and decision for disposition. The output phase includes discharge from the ED, which can include admission to the hospital or discharged home.

Methods

A quantitative retrospective study was conducted at an academic hospital in Gauteng, a province in South Africa. The ethical approval was obtained from the Research Ethics Committee of the Faculty of Health Sciences at the University of Pretoria (No: 246/2015) as well as from the hospital where the study was conducted. This study included the medical records of male and female adult patients' (>18 years), who were managed for medical, surgical or trauma related emergencies in the ED during the period June to August 2015 and had remained in the ED for 12 h or longer. All relevant data were obtained from the study hospital ED registry database. The hospital's admission department use electronic patients' record time while nurses and doctors document their own time. Time variables comprised reception, triage (contact with nurse and doctor), ED admission (contact with nurses, ED doctors and specialist and disposition decision) and admission or discharge from the ED. The total number of patients' medical records that met the unit of analysis inclusion criteria was 1300 from which a 100 patients' medical records were needed for a representative sample. Systematic sampling was used to identify 100 patients' medical records, which were used in this study. During the systematic sampling of patients' medical records that met inclusion criteria of the unit of analysis, a red sticker was attached to each of patients' medical records. An audit tool was used to collect the data from the 100 patients' medical records. The tool developed by the researchers that comprised of four sections: Section A: Demographic information; Section B: Input; Section C: Throughput and Section D: Output (guided by the factors identified in Fig. 1).

Demographic and clinical data were extracted from medical records of patients. Clinical data included all areas of delay within the three phases of the Input-Throughput-Output model (Fig. 1). Captured data was analysed using descriptive statistics to report demographic data and LOS in the ED. Regression analysis was performed to investigate the relationship between areas and prolonged LOS during the input, throughput and output phases in the ED.

Results

From the 100 medical records audited 51 were from women and 49 from male patients. These patients had a mean age (SD) of 50.6 (18.3) years and their ages varied between 18 and 92 years. Twenty four percent of these patients arrived at the ED by the ambulance, while 76% arrived using private transport.

Input phase

The number of patients seen over the different days of the week was very similar, ranging from 13 to 17 patients on the different days. Of the 100 patients who reported at the ED reception area, 61 patients were sent to the triage area while 39 were directly admitted into the ED. The results of triage scores and colours of the 61 patients sent to triage were: orange/very urgent (n = 12), yellow/urgent (n = 28) and green/routine non urgent (n = 21). The average time from where patients reported to reception up to triage was 3 h and 17 min. The length of stay during all three phases of the LOS for the areas of delay during the Input-Throughput-Output phases is shown in Table 1.

Throughput phase

The majority of patients (n = 82) admitted in the ED presented with medical emergencies, while 18 patients were trauma related cases.

Table 1
Summary of the length of stay during Input-Throughput-Output phases.

	Length of stay (hh:mm)
Input phase (reception to triage)	
Reception to first contact with triage nurse	00:55
First contact with triage nurse to first contact with triage doctor	02:22
Sub-total	**03:17**
Throughput phase (first contact with nurse to admitting specialty)	
First contact with triage doctor to admission in emergency department	00:27
Admission to ED to first contact with nurse	00:28
First contact nurse to first contact with doctor	01:43
First contact with doctor to referral to specialist	02:25
Referral to specialist to first contact with specialist	05:15
First contact with specialist to decision for disposition	06:07
Sub-total	**16:25**
Output phase (decision for disposition to discharge)	
Disposition to discharge from emergency department	54:07
Sub-total	**54:07**
Total	**73:49**

Patients presenting with medical emergencies are referred to specialists from internal medicine, which constituted 55% with an average of 6 available beds in the hospital where these patients could be admitted to following their treatment in the ED. The length of stay from the first contact by a specialist to the decision for disposition (6 h 7 min) contributed the most to the total LOS (16 h 25 min) in the throughput phase, followed by referral by the doctor in the ED to a specialist to first contact by specialist (5 h 15 min). Refer to Table 1. A strong significant relationship was found between the LOS and the time taken between being seen by the specialist until the decision for disposition ($p < 0.05$).

The ED is divided into different admission areas, where the average bed capacity over the 3 months was: trauma resuscitation (100%), medical resuscitation (100%), trauma (186%) and female (163%) areas. In addition, the diagnostic and laboratory test requested were as follows: X-rays (n = 100), blood test (n = 98), computerized tomography (CT)-scan (n = 17) and sonar (n = 5).

Output phase

Patients took a mean of 54 h 7 min to be transferred to a ward (n = 82), high care unit (n = 1) and intensive care unit (n = 5), operating theatre (n = 1), other hospital (n = 3) or discharged home (n = 8). The mean overall time (LOS) it took a patient from reporting to reception area (input phase) to being transferred/discharged from the ED (output phase) was 73 h 49 min, which is equivalent to 3.04 days. The output phase contributed the most to the overall LOS.

Discussion

Numerous studies have documented non-urgent visits of patients in EDs as a cause of crowding and prolonged LOS [34,35], while others are of the opinion that non-urgent patients presenting to the ED are not the cause of crowding and prolonged LOS [36]. Results from this study, on acuity showed that of patients who were triaged, 66% were triaged as urgent (urgent and very urgent), while 34% were triaged as non-urgent. Contrary to this study findings in other studies showed that a large proportion (>80%) of non-urgent patients were managed in EDs [37,38].

In this study, the mean waiting time for patients from reporting to the reception area up to being triaged was 3 h and 17 min, which is acceptable compared to the recommended triage waiting time for non-urgent patients in South African Triage Scale (SATS) of 4 h [27,39]. These findings are congruent with the findings of other studies, which reported shorter waiting times of <4 h for non-urgent patients to be

triaged [39]. Contrary to these findings, one interview study that compared the views of ED staff on crowding and prolonged LOS in the Netherlands and Pakistan both reported delays in triage as a contributory factor [40].

Our study showed that majority of patients admitted in the ED were medical emergencies (82%), hence specialists from internal medicine were consulted and continued the management of 55% of patients admitted to the ED. There were however only 6 internal medicine beds available in the wards for these patients to be admitted to, which could have contributed to the prolonged LOS. Similar findings were found in studies conducted in the Netherlands and Hong Kong, where it was reported that the majority of patients admitted to the ED presented with medical emergencies and then referred to specialists from internal medicine, who then remained in the ED for a longer period [23,35,41].

Results of this study showed that the average LOS from the first contact by a specialist to the decision for disposition was 6 h and 7 min. The findings of this study were consistent with studies reporting a significant prolonged LOS in the ED if patients where referred to specialists [42,43]. The findings of the study conducted in Australia reported a mean time of 3 h 57 min from when patients were triaged until the decision for disposition from the ED [42], whereas in this study it took 16 h and 25 min, which is significantly longer.

Diagnostic and laboratory testing are necessary in >90% of patients admitted to the ED and are one of the most important independent determinants of prolonged LOS [41]. Diagnostic (100%) and laboratory tests (98%) requested for patients in this study following admission to the ED could have contributed to prolonged LOS as suggested by others [43–46]. In this study we unfortunately were unable to assess the data and investigate the contribution to LOS relating to diagnostic and laboratory testing requested, which is a limitation that could be addressed in future studies.

This study showed the mean time was 54 h 7 min from decision to disposition to actual discharge or transfer from the ED. Bed availability contributed to the prolonged LOS. Findings from other studies showed that the lack of inpatient beds in relevant units reduced output and exit block contributing to crowding and prolonged LOS in the ED [25,33,47–51]. Our study showed that mean overall time (LOS) from when patients reported to reception to being transferred or discharged from the ED was 73 h 49 min which is equivalent to 3.04 days. Other studies reported a mean LOS of 4 h [42] up to 6 h [47,52,53]. The output phase contributed the most to the overall LOS.

Conclusion

The Input-Throughput-Output model provided a logical framework to identify areas of delay that prolonged patients' length of stay (>12 h). This study showed that LOS in the ED of the studied hospital was high (3.04 days), which could have been affected by the number of patients presenting with medical emergencies and consequently referred to specialists of internal medicine, diagnostic and laboratory tests as well as bed availability.

Understanding causes of prolonged LOS in input, throughput and output phase is essential to ensure appropriate interventions. However, a single intervention cannot be adequate in addressing prolonged LOS, multiple measures should be employed to address the system as a whole. Organized discharge planning including inter facility transfer of patients could be treated or down referred to other facilities should be considered.

We recommend that strategies should be implemented to decrease the LOS, such as to implement a monitoring and evaluation system where healthcare professionals discuss areas of delay and possible solutions for future. Improving coordination and capacity of the hospital bed management by using a computerized bed management system coupled with a dedicated bed manager in the ED who should facilitate the process of inpatient admission. The LOS of patients in the ED remains challenging and should be a focus area to improve the ED functioning.

Declaration of competing interest

The authors declare no conflicts of interest.

Dissemination of Results

The findings from this paper have not been disseminated beyond this publication.

Authors' Contribution

The authors contributed to the conception or design of the manuscript; the acquisition, analysis, or interpretation of data for the manuscript; and drafting the manuscript or revising it critically for important intellectual content: KM contributed 40%, and TH and ZW contributed 30% each. All authors approved the version to be published and agreed to be accountable for all aspects of the work.

Acknowledgements

We appreciate the assistance and the suggestions of Iauma Cooper who edited the paper. In addition, we wish to thank Ilze van Eeden for her contributions as co-supervisor.

References

[1] Carter EJ, Pouch SM, Larson EL. The relationship between emergency department crowding and patient outcomes: a systematic review. Journal of Operational Research 2014;46(2):106–15.
[2] Abo-Hamad W, Arisha A. Simulation-based framework to improve patient experience in an emergency department. European Journal of Operational Research 2013;224(1):154–66.
[3] Forero R, McCarthy S, Hillman K. Access block and emergency department overcrowding. BioMed Central 2011;15(216):1–6. http://ccforum.com/content/15/2/216.
[4] Shetty A, Gunja N, Byth K, Vakasovic M. Senior streaming assessment further evaluation after triage zone: a novel model of care encompassing various emergency department throughput measures. Emerg Med Australas 2012;24(4):374–82.
[5] Huang Q, Thind A, Dreyer JF, Zaric GS. The impact of delays to admission from the emergency department on inpatient outcomes. BioMed Central Emergency Medicine 2010;10(16):1–6. http://www.biomedcentral.com/1471-227X/10/16.
[6] Nugus P, Forero R, McCarthy S, McDonnel G, Hillman K, et al. The emergency department "carousel": an ethnographically-derived model of dynamics of patient flow. Int Emerg Nurs 2013;22:3–9.
[7] Singer AJ, Thode HC, Viccellio P, Pines JM. The association between length of emergency department boarding and mortality. Acad Emerg Med 2011;18(12):1324–9.
[8] Ding R, McCarthy ML, Desmond JS, Lee JS, Aronsky D, Zeger SL. Characterizing waiting room time, treatment time and boarding time in the emergency department using quantile regression. Acad Emerg Med 2010:813–23. https://doi.org/10.1111/j.1553-2712.2010.00812.x.
[9] Beck E, Balasubramanian H, Henneman PL. Resource management and process change in a simplified model of the emergency department. In: Proceedings of the 2009 winter simulation conference; 1887–1895 [Dec 13-16; Austin, TX].
[10] Crawford K, Morphet J, Jones T, Innes K, Griffiths D, Williams A. Initiatives to reduce overcrowding and access block in Australian emergency departments: a literature review. Collegian 2013;21(4):359–66. https://doi.org/10.1016/j.colegn.2013.09.005.
11. Djokovic M. Increased emergency department boarding times. Doctor of Nursing Practice Capstone Projects Paper 2012;13:1–38.
[12] Henneman PL, Nathanson BH, Li H, Smithline HA, FSJ Blank, Santoro JP, et al. Emergency department patients who stay more than 6 hours contribute to crowding. Journal of Emergency Medicine 2010;39(1):105–12.
[13] Mosely MG, Dickerson CL, Kasey J, Key CB, Moore T, Vagarali A, et al. Surge: an organizational response to emergency department overcrowding. Journal of Clinical Outcomes Management 2010;7(10):453–7.
[14] Hsu N, Shu C, Lin Y, Yang M, Su S, Ko W. Why do general medical patients have a lengthy wait in emergency department before admission? J Formos Med Assoc 2012;113(8):557–61. https://doi.org/10.1016/j.jfma.2012.08.005.
[15] Wiler JL, Gentle C, Halfpenny JM, Heins A, Mehrotra A, Mikhail MG, et al. Optimizing emergency department front-end operations. Ann Emerg Med 2012;55(2):142–60.
[16] Borghans I, Kool RB, Lagoe RJ, Westert GP. Fifty ways to reduce length of stay: an inventory of how hospital staff would reduce the length of stay in their hospital. Health Policy 2012;104(3):222–33.

[17] Soong C, High S, Morgan MW, Ovens H. A novel approach to improving emergency department consultant response times. BMJ Qual Saf 2013;22:299–305. https://doi.org/10.1136/bmjqs-2012-001503.
[18] Santos J, Lima M, Pestana A, Garlet E, Erdmann A. Challenges for care management of emergency care from the perspective of nurses. Acta Paulista de Enfermagem 2013;26(2):136–43.
[19] Osei-Ampofo M, Oduro G, Oteng R, Zakariah A, Jacquet G, Donkor P. The evolution and current state of emergency care in Ghana. African Journal of Emergency Medicine 2013;3(2):52–8.
[20] Geelhoed GC, De Klerk NH. Emergency department overcrowding, mortality and the four-hour rule in Western Australia. Medical Journal of Australia 2012;196(2): 122–6. https://doi.org/10.5694/mja11.11159.
[21] Jones P, Schimanski K. The four-hour target to reduce emergency department 'waiting time': a systematic review of clinical outcomes. Emerg Med Australas 2010;22(5):391–8.
[22] Calvello E, Reynolds T, Hirshon JM, Buckle C, Moresky R, O'Neill J, et al. Emergency care in sub-Saharan Africa: results of a consensus conference. African Journal of Emergency Medicine 2013;3(1):42–8.
[23] Vegting IL, PWB Nanayakkara, Van Dongen AE, Vandewalle E, Van Galen J, Kramer MHH, et al. Analysing completion times in an academic emergency department: coordination of care is the weakest link. J Med 2011;69(9):392–8.
[24] Siamisang K, Thlakanelo JT, Mhaladi BB. Emergency department waiting times and determinants of prolonged length of stay in a Botswana referral hospital. OJEM 2020;8:59–70.
25. Talleshi Z, Hosseinine AD, Gorji H. The effect of new emergency program of patient length of stay in a teaching hospital emergency department of Tehran. Nigerian Medical Journal: Journal of the Nigeria Medical Association. 2014;55(2)134–138.
[26] Van Wyk PS, Jenkins. The after-hours case mix of patients attending the George provincial hospital emergency centre. S Afr Fam Pract 2014;56(4):240–5.
[27] Van de Ruit D, Lahri S, Wallis LA. Clinical team's experiences of crowding in public emergency centres in Cape Town, South Africa. African Journal of Emergency Medicine 2020;10:52–7.
[28] Engelbreght A, Du Toit FG, Geyser MM. A cross sectional profile and outcome assessment of adult patients triaged away from Steve Biko Academic Hospital emergency unit. S Afr Fam Pract 2015;57(3):1–6. https://doi.org/10.1080/20786190.2015.1024013.
[29] Asplin BR, Magid DJ, Rhodes KV, Solberg LI, Lurie N, Carmango CA. A conceptual model of emergency department crowding. Ann Emerg Med 2003;42:173–80.
[30] Higginson I, Boyle A. What should we do about crowding in emergency department? British Journal of Medicine 2018;79(9):500–3.
[31] Chaou C, Chen H, Tang P, Pan S, Yen AM, Chiu T. Predicting length of stay among patients discharged from the emergency department – using an accelerated failure time model. PLoS ONE 2016;12(1):1–11. https://doi.org/10.1371/journal.pone.0165756.
[32] Lee I, Chen C, Lee Y, Hsu Y, Lu C, Huang H, et al. A new strategy for emergency department crowding: high-turnover utility bed intervention. J Chin Med Assoc 2017;80:297–302.
[33] Mentzoni I, Bogstrand ST, Faiz KW. Emergency department crowding and length of stay before and after an increased catchment area. BMC Health Serv Res 2019;19: 1–11. https://doi.org/10.1186/s 2913-019-4342-4.
[34] Cimona-Malua TC. Waiting time of patients who present at emergency department of Saint Rita's hospital, Limpopo province, South Africa. University of Limpopo; 2010. p. 1–74. http://hdl.handle.net/10386/539.
[35] Lo SM, Choi KTY, Wong EML, Lee LLY, Yeung RSD, Chan JTS, et al. Effectiveness of emergency medicine wards in reducing length of stay and overcrowding in emergency department. Int Emerg Nurs 2013;22(2):116–20.
[36] White BA, Brown DFM, Sinclair J, Chang Y, Carignan S, McIntyre J, et al. Supplemented triage and rapid treatment (START) improves performance measures in the emergency department. Journal of Emergency Medicine 2012;42 (3):322–8.
[37] AL-Reshidi AA. Contributing factors to patients overcrowding in emergency department at King Saud Hospital Unaizah, KSA. Journal of Natural Sciences Research 2013;3(13):33–41.
[38] Clement N, Businger A, Martinolli L, Zimmermann H, Exadaktylos AK. Referral practice among Swiss and non-Swiss walk-in patients in an urban surgical emergency departments: are there lessons to be learnt? European Journal of Medical Sciences 2010;140:1–5.
[39] Soogun S, Naidoo M, Naidoo K. An evaluation of the use of the South African Triage Scale in an urban district hospital in Durban, South Africa. S Afr Fam Pract 2017;1(1):1–5.
[40] van der Linden MC, Meester B, van der Linden N. Emergency department crowding affects triage processes. Int Emerg Nurs 2016;29:27–31. https://doi.org/10.1016/j.ienj.2016.02.003 [PMID: 26970907].
[41] van der Veen D, Remeijer C, Fogteloo A, Heringhaus C, de Groot B. Independent determinants of prolonged emergency department length of stay in a tertiary care centre: a prospective cohort study. Scandinavian Journal of Trauma. Resuscitation and emergency Medicine 2018;26(81):1–9. https://doi.org/10.1186/s13049-018-0547-5.
[42] Fulbrook P, Jessup M, Kinnear F. Implementation and evaluation of a 'Navigator' role to improve emergency department throughput. Australasian Emergency Nursing Journal 2017;20:114–21.
[43] Hertzum M. Patterns in emergency department arrivals and length of stay: input for visualisations of crowding. The Ergonomics Open Journal 2016;9:1–14. https://doi.org/10.2174/1875934301609010001.
[44] Driesen BE, Van Riet BH, Verkerk L, Bonjer HJ, Merten H, Nanayakkara PW. Long length of stay at the emergency department is mostly caused by organizational factors outside the influence of the emergency department: a root cause analysis. PLOS One 2018;13(9):1–15.
[45] Song H, Tucker A, Murrell K. The diseconomies of queue pooling: an empirical investigation of emergency department length of stay. Havard Business School 2013;14:1–39. http://nrs.havard.edu/urn-3:HUL.instRepos:11591702.
[46] Chmiel C, Huber CA, Rosemann T, Zoller M, Eichler K, Sidler P, et al. Walk-ins seeking treatment at an emergency department or general practitioners out-of-hours service: a cross-sectional comparison. BioMed Central Health Services Research 2011;11(94):1–10.
[47] Mason S, Knowles E, Boyle A. Exit block in emergency department: a rapid evidence review. Emerg Med J 2016:1–24. https://doi.org/10.1136/amermed-2015-205201.
[48] van der Linden MC, Khursheed M, Hooda K, Pines JM, Van Der Linden N. Two emergency departments, 6000 km apart: differences in patient flow and staff perceptions about crowding. Int Emerg Nurs 2017;35:30–6. https://doi.org/10.1016/j.ienj.2017.06.002 [28659247].
[49] Shen X, Wang X. Improving the health care delivery process at hospital emergency services by a better use of inpatient bed information. Electronic Commerce Research and Applications 2015;14:14–22.
[50] Vegting N, Alam N, Ghanes K, Jouini O, Mulder F, Vreeburg M, et al. What are we waiting for? Factors influencing completion times in an academic and peripheral emergency department. Netherlands Journal of Medicine 2015;73:331–40.
[51] Driesen B, van Riet B, Verkerk L, Bonjer H, Merten H, Nanayakkara P. Long length of stay at the emergency department is mostly caused by organizational factors outside the influence of the emergency department: a root cause analysis. PLOS ONE 2015;13(9):1–5. https://doi.org/10.1371/journal.pone.0202751.
[52] Plunkett PK, Byrne DG, Breslin T, Bennett K, Silke S. Increasing wait times predict increasing mortality for emergency medical admission. European Journal Emergency Medicine 2011;18(4):192–6.
[53] Janssen MAP, Van Achterberg T, Adriaansen MJM, Kampshoff CS, Schalk DMJ, Mintjes-de Groot J. Factors influencing the implementation of the guideline 'Triage in emergency department': a qualitative study. J Clin Nurs 2011;21(3–4):437–47.